

# Use of heterogeneous regenerators in sub-20K pulse tube applications

Completed Technology Project (2012 - 2012)



## Project Introduction

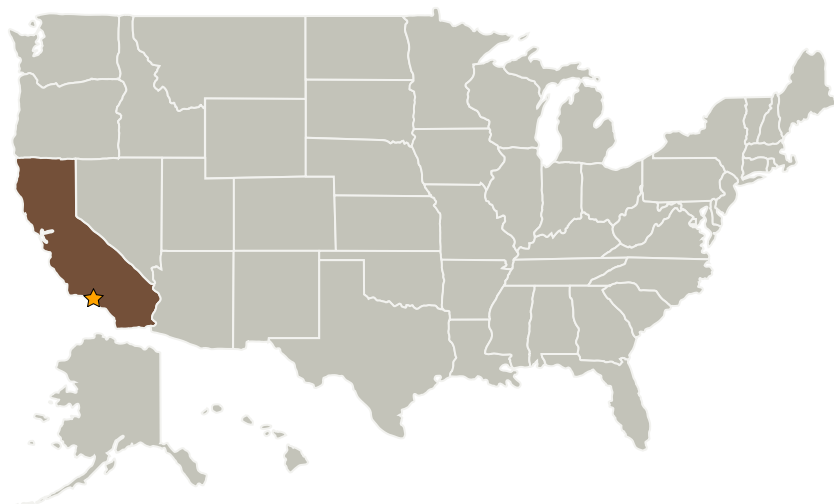
Pulse tube refrigerators are typically built with homogeneous regenerators. At higher temperatures ( $T = 35$  K), heat capacity variations of the regenerator with temperature do not limit performance. At lower temperatures ( $T < 20$  K), regenerator materials are strongly peaked and limit performance over the range of the regenerator. We propose to develop regenerators that have the heat capacity of each region tailored for the temperature distribution.

Pulse tube coolers at high temperature have offered increased efficiency and reliability over older cooler technology.

## Anticipated Benefits

Many missions that are planned or currently in development require cooling below 35 K, and some to temperatures below 100 mK. Refrigerators (primarily pulse tube and Stirling) to  $\sim 35$  K are readily available in the aerospace industry, but lower temperature stages are not. This technology will improve the performance of pulse tube cryocoolers operating at 10-20K. This a base temperature for some missions, and is a required intermediate temperature for lower temperature refrigerators.

## Primary U.S. Work Locations and Key Partners



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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

### Responsible Program:

Center Innovation Fund: JPL CIF

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| Organizations Performing Work    | Role              | Type        | Location             |
|----------------------------------|-------------------|-------------|----------------------|
| ★ Jet Propulsion Laboratory(JPL) | Lead Organization | NASA Center | Pasadena, California |

| Primary U.S. Work Locations |
|-----------------------------|
| California                  |

## Project Management

### Program Director:

Michael R Lapointe

### Program Manager:

Fred Y Hadaegh

### Project Manager:

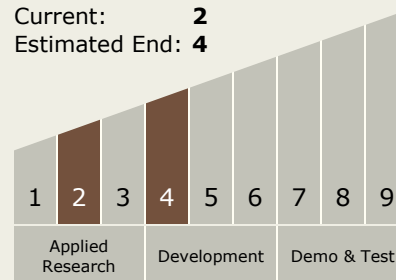
Jonas Zmuidzinias

### Principal Investigator:

Mark J Lysek

## Technology Maturity (TRL)

Start: 2  
Current: 2  
Estimated End: 4



## Technology Areas

### Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors